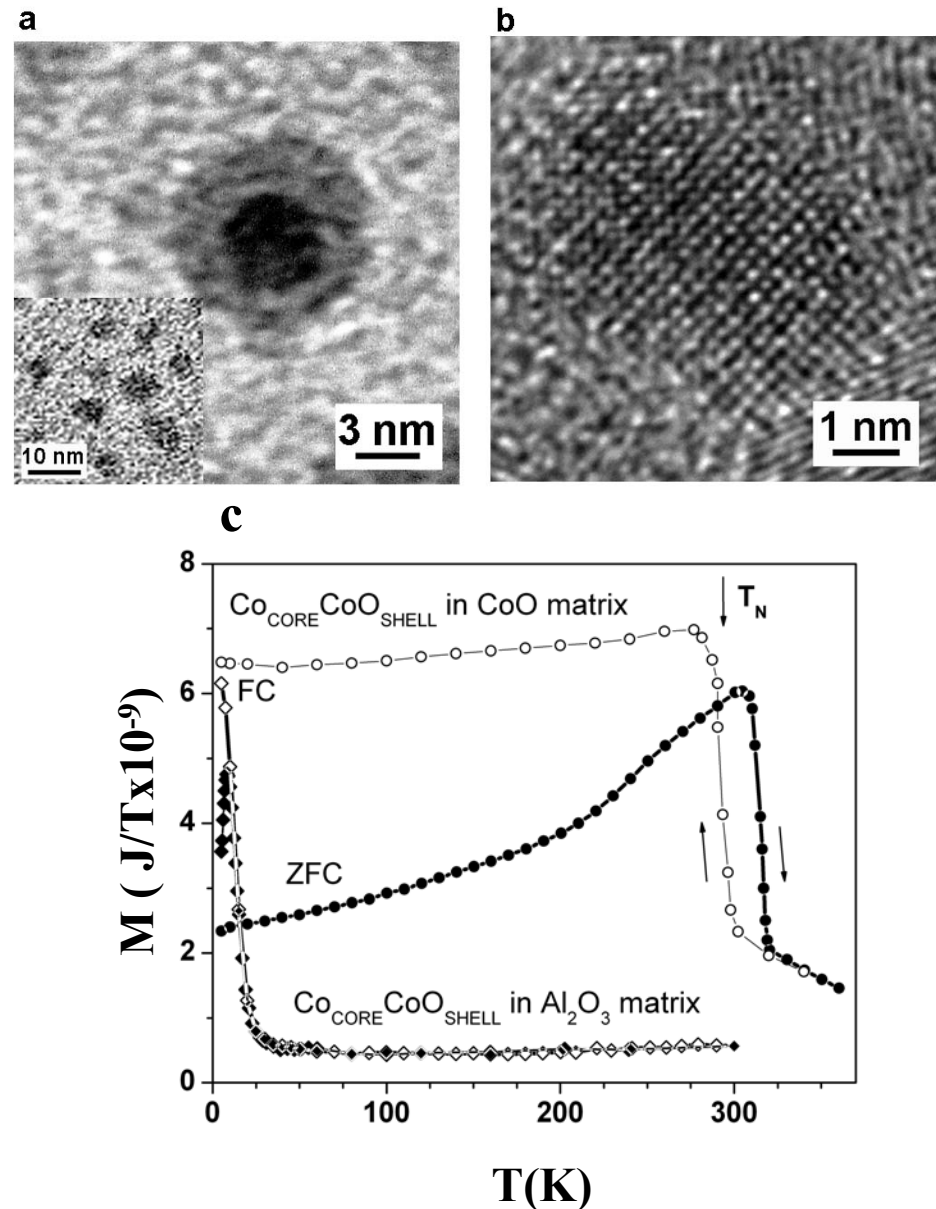


High Anisotropy Magnetic Nanoparticles and Nanocomposites

George C. Hadjipanayis, University of Delaware, **DMR-0302544**

As magnetic nanoparticles are reduced in size they become thermally unstable and the onset of superparamagnetism affects their ability to remain magnetized above their blocking temperature. The future growth of magnetic recording capacity depends on the ability of magnetic nanoparticles to remain magnetized as their size continues to be reduced. At the University of Delaware we have shown that by embedding the magnetic nanoparticles in a matrix consisting of an antiferromagnetic material the magnetic nanoparticles remain magnetized well below their superparamagnetic size. This is made possible through the exchange bias interaction with the antiferromagnetic matrix material). Figure (a) shows a bright field TEM image of a 3nm Co nanoparticle surrounded by a 3nm CoO shell and the inset shows the distribution of Co nanoparticles in the matrix; (b) HRTEM image of a single Co nanoparticle with [001] fcc crystallographic orientation; (c) shows the magnetization as a function of temperature. When the Co nanoparticles are embedded in a nonmagnetic matrix (Al_2O_3) they are superparamagnetic with $T_B=10\text{K}$ while when are embedded in the antiferromagnetic CoO matrix they are thermally stable showing no evidence of superparamagnetism.



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- **Education:** As part of its overall mission the Magnetism Lab at the University of Delaware provides a number of opportunities for students. Drawing on an international flavor the lab has included 2 undergrads (Alex Klaissig (UD) and Paula Wang (visiting student from CMU)), 8 graduate students (including three female students and a German exchange student) and 4 postdocs who have made contributions to the research endeavor in the lab.



Magnetism Group

- **Outreach:** In addition to the year-round population the Magnetism Lab is involved with the Physics department's summer internship program. This program attracts annually approximately 35 talented students from local area high-schools to the open house. From this applicant pool students are chosen to participate in research for the summer and in special cases for part-time work during the semester. The Magnetism Lab has hosted four of these students (Jason Lee (Newark H.S. Senior, Kyle Nizolek (Wilmington Charter H.S. Sophomore), Dave Safranski (St. Mark's H.S. Senior), Roman Sherriff (William Penn H.S. Senior) and Jerome Joynes (St. Mark's H.S. Senior).



High School Students/ Open House